NATURAL HISTORY OF BIRDS.

ALEX. AGASSIZ. CAMBRIDGE. MASS. OCT 3 1868

LECTURES ON

ORNITHOLOGY

IN TEN PARTS,

BY

GRACE ANNA LEWIS.

PART I.

"The little birds sang East, and the little birds sang West,—
Toll slowly!
And but little thought was theirs, of the silent antique years,
In the building of their nest."

J. A. BANCROFT & CO.
512 Arch St.,
PHILADELPHIA.

1866.

"Hast thou named all the birds without a gun?
Loved the wood-rose, and left it on its stalk?
At rich men's tables eaten bread and pulse?
Unarmed, faced danger with a heart of trust?
And loved so well a high behavior,
In man or maid, that thou from speech refrained,
Nobility more nobly to repay?
O, be my friend, and teach me to be thine!"

Entered according to Act of Congress, in the year 1868, by
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TO

PROF. JOHN CASSIN,

VICE PRESIDENT ACADEMY OF NATURAL SCIENCES

OF PHILADELPHIA,

IN REMEMBRANCE OF THE MANY

PLEASANT HOURS SPENT IN HIS INSTRUCTIVE SOCIETY;

AND

TO OTHER FRIENDS

ON EARTH AND IN HEAVEN, WHO HAVE AIDED, ENCOURAGED

AND INSPIRED ME,

THIS VOLUME IS GRATEFULLY DEDICATED

BY

THE AUTHOR.

1866.

PREFACE.

The preparation of this work grew out of the needs of its Author, and it may therefore meet the wants of similar minds.

In attempting the study of Ornithology, the diverse opinions of Authors, equal in standing, tended to neutralize each other. The only remedy was the study of their observed facts, in the hope of reaching the principles upon which animal life is grouped.

The following pages contain the result of laborious investigations, and the interpretations which suggested themselves to my own mind. They were thrown into shape for the use of classes, and in their preparation, the aim has been to present in the smallest possible compass, and in the least expensive form, the leading principles of Ornithology. In obtaining facts, I have gone to the highest sources at my command, and have sought to enrich my work with that which is excellent, only venturing on the new when it was impossible to convey my own convictions without it.

The Ornithological facts given by Gray, Gould, Jerdon, Bonaparte, Strickland and Melville, Wilson, Audubon, Cassin, Baird and Lawrence, Brewer and others, with the Classification of Cuvier, as modified by later systematists, are the basis of the arrangement which has been adopted. Besides these, as occasion required, I have drawn from Oken, McLeay, Darwin, Dana, Lyell, and others, and largely from Agassiz.

Supposing myself to be unsupported by any authority, with great diffidence I treated the Ostrich-like Birds as early forms, and as belonging to a sub-class lower than those including all other existing birds. By the kindness of Prof. Cassin and Dr. Allen of the Academy of Natural Sciences, I was made acquainted with the pamphlet of Prof. Huxley, in which substantially the same views were expressed, the opinions of that eminent naturalist being derived from an examination of the palatal bones of birds, while my own were reached from general considerations. Thus sustained in part, I submit the whole arrangement which I have used, to the public.

Should my publishers meet with sufficient demand, they will proceed with the remainder of the work, which will be completed in ten parts.

The first part, now published, treats of general principles, and is to be understood as introductory. The remaining parts will be devoted to the structure and further classification of birds; to their plumage, with its exquisite forms and colors, and the microscopic appearance of the *down* of young; to their nesting habits, guiding instincts, songs, affections and mi-

gratiions; to the relations of physical causes to the residences of birds; to their geographical distribution, and to their importance to the well-being of civilized nations. There will be added a briefly descriptive catalogue of the Birds of the Middle States, with many of the most beautiful or remarkable birds of the world; a glossary of scientific terms; and a catalogue of a few of the most important Ornithological works, for the use of those who intend to prosecute the study.

I here desire to express my obligations to numerous personal friends and others; amongst them to Dr. William Darlington, of venerated memory, whose intention it was to write a preface, but who, in ripe old age, passed away from earth before my work was finished, and to Daniel B.Smith of Germantown, for the use of valuable books; to S. S. Rathvon, of Lancaster, Penna., a self-made man of the noblest type ,who has won an enviable reputation as an Entomologist; to Jacob Stauffer, and to Dr. J. P. Trimble, for observations in regard to insects; to Dr. Michener, and Vincent Barnard of Chester County, Pa., for access to their Cabinets, and other favors; to Dr. J. Gibbons Hunt of Philadelphia, for the generous offer of the use of his superb microscope, and for a series of examinations of the feathers of birds, and the *down* of nestlings; to Profs. Henry and Baird of the Smithsonian Institute for valuable books and pamphlets; to Prof. Hitchcock of Amherst College, Mass., for information in regard to the egg of the Æpyornis; to Prof. Henry Hartshorne for his kindness in reading proofs; to the gentlemen of the Academy of Natural Sciences of Philadelphia, for the facilities of the Academy during a prolonged course of study; and to the Rev. T. C. Porter, Professor of Natural History in Lafayette College, Easton, Penn., and to Prof. John Cassin, for the influence of their names and position. To the latter gentleman, I am under especial obligation. A *sesame* to the scientific world, his name will ever be cherished by me as that of an instructor and friend.

Trusting to their pardon, I would mention in this connection, the names of my friends Elijah F. Pennypacker and wife of Schuylkill, Penn; Samuel W. Mifflin and wife of Columbia, Penn.; C. C. Burleigh and wife of Florence, Mass.; Hannah M. Darlington of Kennet Square; Abby Kimber, Alice Lewis, and Mary Peart of Philadelphia, as of those who sought opportunities of rendering assistance. Of the latter I would speak as an accomplished artist, whose work, even in the simple illustrations required, I was proud to associate with my own. To these, as well as to Mrs. E. H. Cleveland, M. D.; Ann Preston, M. D.; Miss Rachel Bodley, M. L. A.; Mrs. E. H. and Miss M. L. Stockton, Lydia Gillingham, Edward Townsend and wife, Mrs. E. S. Turner, Mrs. M. J. Burleigh, E. M. Davis and my revered friends James and Lucretia Mott, I would return thanks for that most precious of gifts, moral support.

Remembering many others, I do not name them here.

G. L.

Sunnyside, Kimberton, Chester Co., Penn., July 12th, 1868.

1866.

NATURAL HISTORY OF BIRDS.

"The animal system is a multifariously constructed temple, with its nave, choir, chapels and towers." OKEN.

We have chosen for our subject the Natural History of Birds, not because the science of Ornithology is more interesting than its related branches, but because the love of birds is almost universal, and it is something to bring with us the magic of affection, when we would attempt to turn the keys of scientific lore.

As we proceed, the distinctions which exist within the class of birds will become obvious. These distinctions are analogous to those which exist in every class of animals, and being a part of one general plan, they are worthy of the profoundest study.

In the progress of the sciences, there is a gradual transition from the consideration of phenomena, to their underlying spiritual causes. It is no longer the sage and the philosopher only, but the man of ordinary culture also, who recognizes matter as the transitory, not the permanent—the vesture, not the *life* of Creation. It is the *laws* which govern matter, not the material forms themselves, which prove of the most vital interest.

The student of Natural History, using the material forms to detect the laws, dares to ask the Creator *how* he has wrought, and if over many questions, still broods the unbroken silence of the Ages, some replies are won, and these being answers from the mind of the Eternal, most bounteously repay the labor of investigation, be it ever so toilsome.

When the Mandate of Creation was heard, and Chaos obeyed; when sun and moon and star appeared; when earth rose up to be adorned with grass, the herb bearing seed, and the fruit tree bearing fruit; when the waters brought forth abundantly and in the firmament flew every winged fowl after his kind; when on the dry land moved every beast and creeping thing, and over all, MAN was placed with power and with dominion, then God saw everything which he had made, and behold it was good!

Looking at a far wider expanse than the inspired writer saw, in heavenly vision, Science and Religion, with clasped hands, bend in adoration before the wonders of creation, and in humility, born of a noble comprehension, repeat "It is good!"

There is no department in nature which does not reveal the operations of the same power which is felt in the interior being of every spiritual life—matter or spirit, all is controlled by the Loving, the Ineffable, the Divine.

The proper starting point in Ornithology would seem to be the egg, since all animals originate in *ova*.

While it is not our intention to recall even the substance of that which has been revealed by the microscope in relation to the true or ovarian egg, it will be needful to remember, that it is this minute speck, requiring the aid of powerful glasses to detect its constitution, which is the same or nearly the same throughout the whole animal kingdom.

Some animals, during their whole lives, are nothing but a single cell, and all organized structures, whether animal or vegetable, are built up entirely of cells. Be it root, stem, leaf, or flower, lowest Radiate, or noblest man, all organisms, however various in function, grow by the multiplication and deposition of cells. All cells consist of an outside bag, enclosing an inner sac, within which there is a dot. At one stage of their existence all eggs consist of an outer sac, an inner sac

and a dot, and they then differ from other cells only in having within themselves, the formative principle of life.

In speaking of this mysterious principle, AGASSIZ says: "This intangible something is the subtile element that eludes our closest analysis; it is the first indication of the immaterial principle according to which the new being is to develop. The physical germ we see, the spiritual germ we cannot see, though we may trace its action on the material element through which it is expressed."

Having within itself this absolutely unknown principle of life, the single egg cell multiplies until a yolk is formed, each of its component cells having a like power of self-multiplication. About the time the yolk drops from its formative bed, or the ovary, there is a remarkable increase in the number of these cells. As fast as the work of cell production is completed, each outer sac bursts and sets free a new generation of cells. And now, obedient to some hidden law, this army of workers marches to headquarters to await further orders; as soon as set free, the cells arrange themselves in that part of the egg where the embryo is to arise, or more accurately speaking, cell multiplication takes place earliest in the region of the coming embryo. When first freed from their envelopes, the cells are in heaps, just as they burst from their sacs, but they soon arrange themselves along the germinal layer, and this is their state of preparation in the egg when it is deposited.

By opening a perfectly fresh egg, the spot in which the microscopic germ lies may be distinctly seen on the centre of the yolk. When incubation has continued for a short period, it may be very clearly perceived by holding an egg before a light, when, as the egg is turned, the yolk, swinging on albuminous axles, sustains the germ, holding it on its upper surface in perfect safety.

This suspension of the germ, familiar to every housewife, not only affords an example of the exquisite simplicity of the mechanism of nature, but it also marks a definite stage in the

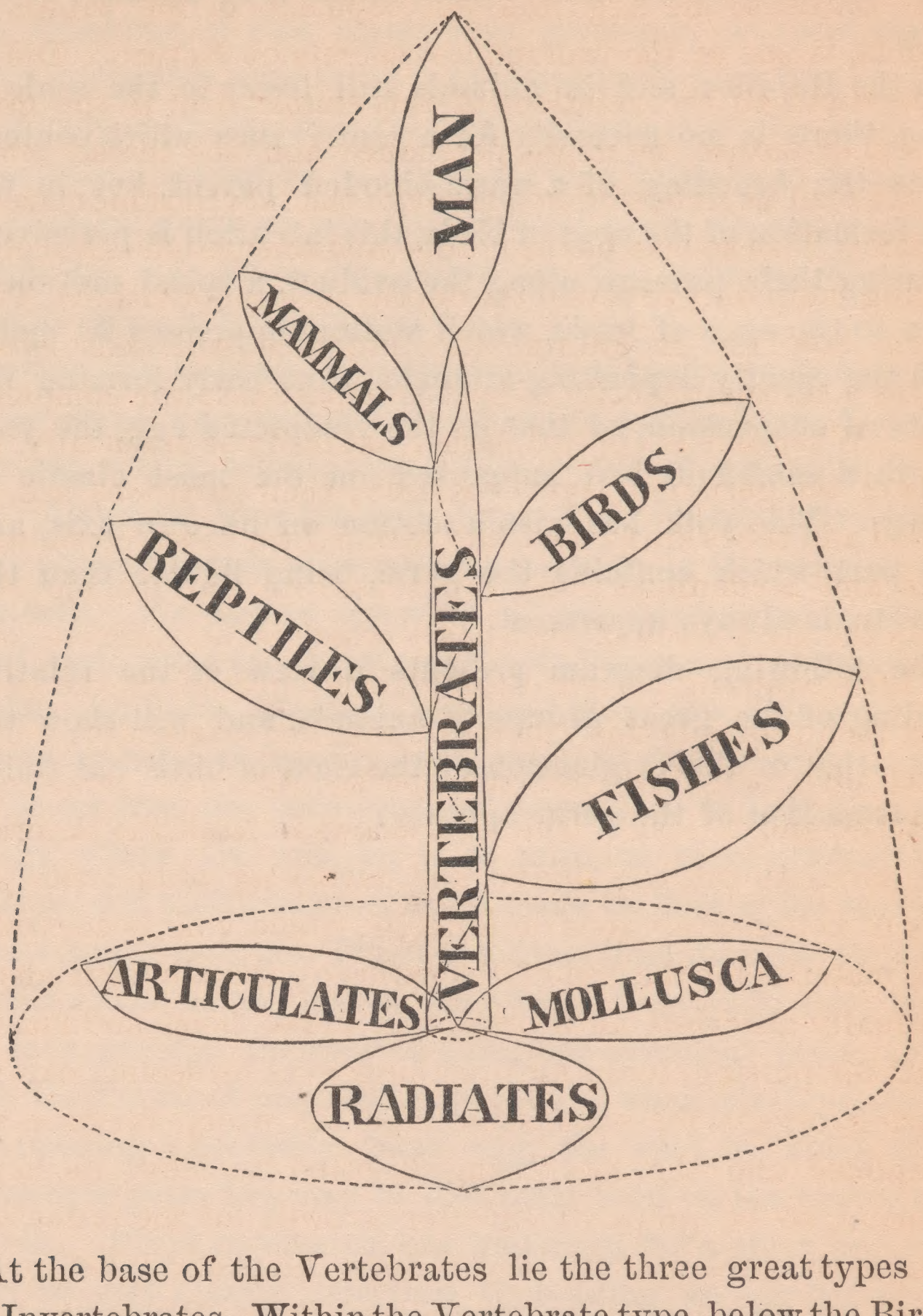
progress of creation—the advent of the Warm-blooded animals—it is one of the mile stones in the long advance of the Ages.

In the Reptiles and in animals still lower in the scale of being, there is no necessity for a contrivance which contemplates the brooding of a warm-blooded parent, but in the very formation of the eggs of birds, this intention is perceived.

During their passage along the oviduct, a spiral motion is given to the eggs of birds, which motion impresses its spiral upon the rapidly depositing albumen, thus early forming the points of suspension, so that in the completed egg, the yolk lies in a semi-fluid bed supported on the most elastic of springs. The yolk has also a motion on its own axis, and that part which contains the germ, being lighter than the opposite, is always uppermost.

The following diagram presents a view of the relative standing of the great groups of animals, and will show the point—that of the origination of the class of birds—at which the suspension of the germ appears:

FIGURE 1.



At the base of the Vertebrates lie the three great types of the Invertebrates. Within the Vertebrate type, below the Birds, are the Fishes and the Reptiles. Trifling as it may seem, the rising of the germ to meet the warm bosom of the mother, in reality marks the whole distance from the lowest Radiate to the Warm-blooded animals, earliest of which are the Birds. Higher than these are the Mammalia, and supreme above all, distinguished by intellect and the possession of the religious

faculties, is Man, at once the superior, the type and the representative of the whole animal creation.*

To return to the egg: the development of life within its bounds, is one of the profoundest secrets of Nature. Did we understand all the relations of this simple oval to the great system of nature, we might perchance hold the thread, which would lead us unbewildered through the labyrinthine mazes of creation. This no man has ever done, and science offers her glimmering lamp only to reveal the depths she cannot fathom. Thus much however is known—the life-force will not evolve unless a certain quantity of heat is imparted to the completed egg. When this is applied, either naturally or artificially, the cells of the germinal layer coalesce; their partitions are absorbed and tubes are formed, and within these tubes, elementary cells and albuminous fluid are tossed to and fro, and thus beats the first throb of that heart which is hereafter to send the life-sustaining current through every portion of the body. And then proceeds this wonder of wonders—according to the exact plan laid down for the species, the new creature is sketched and formed. The ideal draws to itself the material; cell moves to cell in a divine and unvarying order; the process of cell-making goes on until the whole yolk is converted into material for the use of the embryo; the albumen also is gradually absorbed until brain and nerve, bone and muscle, heart for pulsing, lungs for breathing, eyes for seeing, ears for hearing, organs for each sense and for every function are completed, and the new being is fitted to leave its imprisonment, to be prepared by after growth for the fullness of enjoyment, perfect of its kind. Says Agassiz: "Before the lungs breathe, they make themselves; before the stomach digests, it makes itself; before the organs of the senses act, they make themselves; before the brain thinks, it makes itself. In a word, before the whole system works, it makes itself

*Some naturalists of high standing refer man to a distinct kingdom; I have represented him as forming a separate class. Man *is* a Mammalian, but he is much more. He is "the bright consummate flower" of "things that live."

out of the elements given by the formation of the independent eggs. Its first office is self structure." Within the egg are evolved those peculiarities which characterize the species, the genus, the family, the tribe, the order, the sub-class, the class; and, taking a wider range than birds, the type itself. It is then perfectly true, that life, clothed in obedient matter, is a far greater miracle than are the stars in their courses

Naturalists form no one of the groups which are determined even in the embryonic condition of the animal. They only detect them where they already exist.

It is true, much depends on the skill of the Naturalist. He must be able, in the manner of men, to read nature. Keen of observation, nice in discrimination, of intuitive perceptions, and endowed with large powers of generalization, he must yet possess such reverence for Truth, that he will follow her and her only, let her guidance be where it may.

The simplest questions are the earliest solved, and none need wonder that just in proportion to range of vision, is the uncertainty as to the ultimate principles of classification. Many may believe, no man knows, that he has conceived in their true grandeur, the thoughts which underlie the arrangement of the animal kingdom.

There are however well ascertained facts, and these may be reverently interpreted. If these interpretations should differ widely, it need be no cause of discouragement. The everlasting truth remains, and it is each man's privilege to endeavor to find it.

Geologists tell us that: "The starting point of a class or other kingdom of life was often from the top of its lower division and the bottom of the next above, or from an intermediate level between the two. Plants began at the middle of the scale, Fishes at the top; in fact the commencement was at a point above the true level of the Fishes, verging towards the higher grade of Reptiles."*

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*DANA.

Among Birds, it is generally agreed by Naturalists that the group to which the Ostrich belongs, the *Struthiones*, approaches most nearly to the Mammals, while the Swimming birds, especially the Penguins, reach downward towards the Fishes.

The Birds therefore show affinities for Vertebrates which are higher, as well as for those which are lower than themselves. They appear to have originated nearest to the Reptiles, and to have commenced their existence as a class with reptilian representatives.† Such was probably the earliest bird known to Geologists, the *Archæopteryx macrurus*, found in Limestone belonging to about the middle of the Mezozoic Time. This bird was, according to Owen, Ostrich-like in character, whilst others perceive its affinity to the Wading birds. Both views may be correct, since it has long been conceded that in the class of Birds the Waders are the especial representatives of the Reptiles. The feet of this bird were unwebbed: it was evidently no swimmer.

The Ostriches themselves partake so much of the nature of the Wading birds, that they are alternately held as Walkers and Waders, Cuvier classing them with the latter. Professor Owen tells us that our wading Coots are only modified Cassowaries, while the Cranes, the Bustards, the Tinamous and others, stand so nearly upon the borders of different groups, that diversity of opinion respecting them, may easily arise among the best of Naturalists. Weighing all the testimony with care, the most reasonable conclusion appears to be that, while having all the characteristics of true Birds, the first of the class were repetitions of the Reptilian type of animal; that these birds were of the comprehensive, synthetic, or undivided types, having within their own natures, to use the words of AGASSIZ, "A prophecy of the future, as well as a memory of the past;" that after these, must have developed the true ideals of bird life, harmoniously with the development of the earth, and its vegetable and other animal existences;

†Professor Huxley speaks of the two groups of Reptiles and Birds, as "Connate at Base."

and further, that the *Archæopteryx macrurus*, was the far away predecessor of the group containing our present Struthiones, or such birds as the Ostriches, the Cassowary, the Emeu and the Apteryx, *and also of the Dodo and all its kindred*; and that this group may be considered as a primary sub-class, having within itself two sections, the birds known as the *Struthiones* forming one section, the Dodo and its kindred the other.

Birds naturally divide into *Præcoces*, or those which are active at birth and are also self-feeders; and *Altrices*, or those which require a nursing mother; the latter being helpless, are fed by their parents until they gain sufficient strength to provide for themselves.

Even in the early group to which we have alluded the two sections probably existed. The *Struthiones* are decidedly *Præcoces*. Too little is known of the *Dodo* and its allies to warrant any positive assertions. While the majority of those who have made these birds a study, assign them to the *Columbæ*, Professor J. F. Brant speaks of the Dodo as "an anomalous link connecting several groups, a link which inclines towards the Ostriches, and especially towards the Pigeons,"—just such relationships as a primordial bird of the *Altricine* section would have. To my own mind there is little doubt that the two sections of *Præcoces* and *Altrices* did exist even in the first sub-class of birds.*

The second sub-class includes three very natural divisions: the Wading, the Swimming and the Walking birds. In each of these three groups appears very decidedly the bisection commenced in the first sub-class. The Swimming group has its *Præcoces* and its *Altrices*, so have the Waders and so have the Walkers.

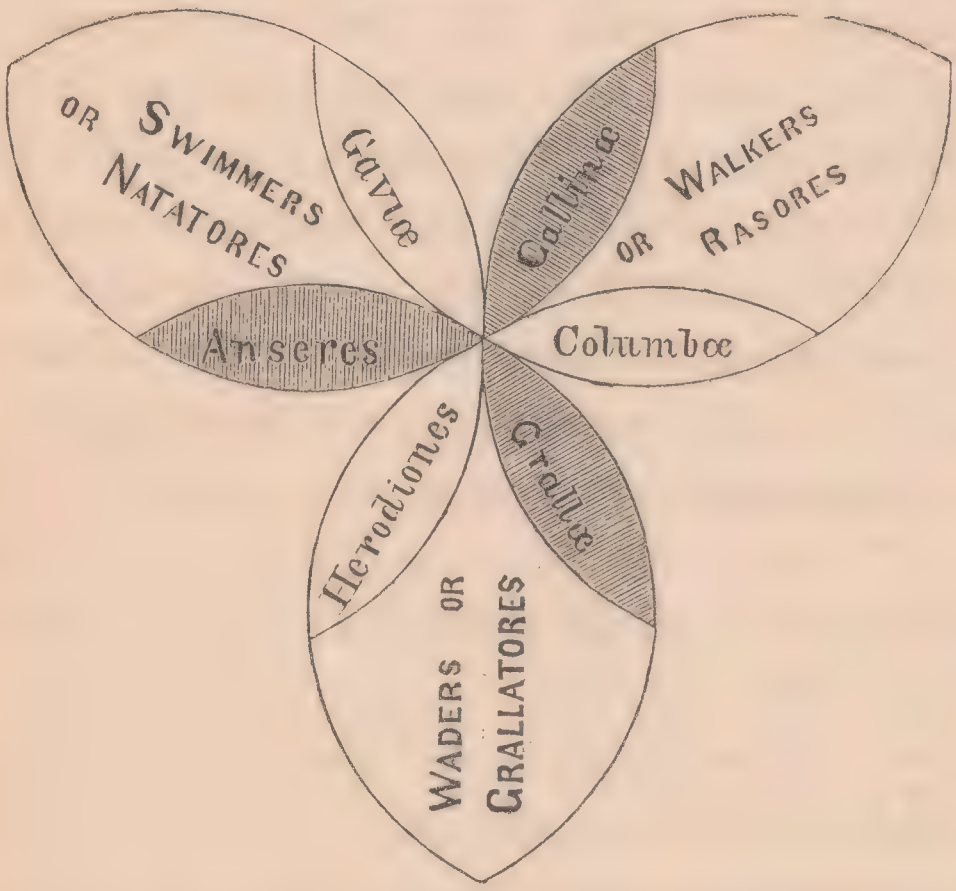
Each division therefore includes two groups or sections; there being three divisions, we have consequently six groups or sections Three sections, one from each division, form a

*Professor Huxley makes the *Archæopteryx* one sub-class, the *Struthiones* a second, and all other birds a third.

connected series, the remaining three sections forming a second series. The lower series contains the *Præcoces*, the higher the *Altrices*, and alternating with each other the whole six sections form a complete circle or whorl.

The relations of the divisions and the series will be better understood by considering the plan on which a tulip is are ranged. It will be seen that the outer petals of this and many other flowers form a perfect triangle. The inner petals form a second triangle, whose points alternate with those of the first. Let the outer triangle of petals represent the *Præcoces*, and the inner triangle the *Altricees*, and the illustration is complete. The plan of the flower and of the sub-class are one.

FIGURE 2.



In figure 2, the darkened sections are intended to represent the *Præcoces*—the outer triangle—the unlined sections show their complementary groups, or the *Altrices*, corresponding to the inner triangle of the tulip.

The Division of the Swimmers, Natatores or Palmipedes contains birds which are all web-footed, and nearly all inhabit water, either salt or fresh. Where exceptions occur, it is in species verging towards groups of a different character.

The first section of this division, the *Anseres*, nearly if not quite identical with the *Lamellirostres*, contains the Ducks, the Geese, and the Swans. These are held to be of one family, the differences being supposed to be those belonging to the sub-family only. The group is remarkably simple.

The second section, or the *Gaviæ*, equivalent to the *Simplirostres*, includes a number of families, such as the Pelicans, the Cormorants, the Gannets, the Darters, the Frigate Pelicans, the Gulls, the Albatrosses, the Petrels, Auks, Guillemots, the Divers, (or the Loons, and the Grebes,) and the Penguins. They are nearly all sea-birds; some of these are of a very sluggish habit, possessing only a slight degree of nervous sensibility, whilst others, and especially those most highly organized for flight, possess remarkably active temperaments. The group divides into three or more tribes, and amongst these, wide differences of form, structure and temperament exist. In the tribe of the *Longipennes* or Long-wings is found the Albatross, with the longest wing bones of any bird in the whole class, while in the tribe of the *Brachypteri* or Short-wings are the Penguins, whose wings are depressed to the purpose of fins, the very feathers taking on the semblance of scales. Within their sub class these birds range almost from one extreme to the other.

The members of one whole tribe of the *Gaviæ* are endowed with a special organ for carrying food to their young, this organ being best represented by the pouch of the Pelican.

The Divers appear to be a transition family, and to hold a middle station between the *Anseres* and the *Gaviæ*. They are alternately classed with one section or the other according to the opinion of Ornithological writers.

The Wading birds, or the *Grallatores*, are usually only partially web-footed. In structure the foot is intermediate between that of the swimmer and the land bird, just as the destiny of the creature is intermediate between land and water. Some tribes, in their habits, tend toward the land,

others toward the water, each tribe manifesting a corresponding inclination of structure.

Of the two sections found among the *Grallatores*, that of the *Grallæ* includes the allies of the Wood-cock, the Snipe, the Plover, the Rail, the Coot, &c., &c. That of the *Herodiones* covers all of the Heron and Stork kind. Here are classed the Ibis, the Spoon-bill and usually the Cranes and the Flamingo, although by some authors the latter family is placedwith the *Anseres*.

Among the Walking Birds, or the *Rasores*, the *Gallinæ* includes all birds having an organization similar to the common barn-door fowl, such as the Turkey, the Pheasant, the Partridge, &c., &c ; the *Columbæ* contains only the Pigeons and Doves. Among them, some writers perceive the existence of at least four families.

To recapitulate : the series of the *Præcoces* includes the *Anseres*, the *Grallæ* and the *Gallinæ*; the series of the *Altrices*, the *Gaviæ*, *the Herodiones*, and the *Columbæ*.

There are certain easily remembered characteristics, belonging to each series, any one of which is sufficient to distinguish their members, just as Endogenous plants are distinguished from Exogens by any one of several characters.

In the eggs of members of the *Præcocial* series, the air chamber is large, for the better oxygenation of the blood of the embryo; before expulsion from the egg, the chick is covered with a growth of *Down* to serve for protection until the true feathers appear; the young animal is remarkable for its strength, and is able at once to follow the parent and to feed itself. The voice is a distinct "peep," a cry never heard from a true nestling. As contrasted with birds of the higher series, the *Præcoces* are numerous egg layers, a portion of them, as the majority of the *Gallinæ*, being excessively prolific. They usually build on the ground and rear their young there, or, in the case of the swimmers, lead them to water. When inattention to mating occurs, it is in this series, or in the sub-class

below it. The *Præcoces* are the "Game Birds" of the world.

In the eggs of birds of the second series, or the *Altrices*, the oxygenating chamber is small. Possibly in a majority of cases the young are hatched with covering, but as a nestling plumage, it is a question whether any true down appears. In the Turtle Dove (*Zenaidura carolinensis*) and the domestic Pigeon, the young are covered with bundles of filaments destitute of barbs. In the Dove, these surmount the sac enclosing the young feathers. Under the microscope these filaments appear like simple hairs.

Among the *Gaviæ* and the *Herodiones*, length, pluminess and silkiness of texture, compensate for sparseness of covering. In this series the nestling plumage appears to proceed only from the sacs destined to mature the true feathers, and being attached to the barbs of the latter, it is thrown off when it has served its purpose.

The *Altrices* deposit but few eggs; sometimes only one, rarely exceeding five in number; where exceptions occur, it is in families bordering on the *Præcoces*. In the case of the Pigeons there is a compensation by frequency of deposit.

Birds of this series usually place their eggs in nests, and these, most frequently, are found in some elevated situation. Exceptions, however, occur in almost every family.

Altricine birds are helpless for a longer or shorter period after expulsion from the egg. They remain on the spot of their birth until they acquire strength for locomotion; and for a certain period are fed by their parents. In reference to this latter fact they are known as the *Heterophagi*, while the *Præcoces* are distinguished as the *Autophagi* or self-feeders.

Some *Altrices* are born blind as well as helpless, and on the authority of Audubon, the young Cormorant is nude also.

While the two series evidently result from the same effort of growth, the *Altrices* are undoubtedly the highest expression of bird-life belonging to their sub-class. They are apparently intermediate between the *Præcoces* and the *Insessores*.

Within this sub-class are birds which partake of the nature of both series, and are at the same time a connecting link between the divisions. Such appear to be the Bustards, Cranes and Tinamous, which lead from the Ostriches; the Flamingoes, the Cariama, and the Megapodidæ; birds which must be considered as lower in Ornithological standing than either the *Præcoces* or the *Altrices*, and which are apparently the synthetic, comprehensive, or undivided types of their sub-class, just as the *Archæopteryx* and the Ostrich-like birds are the comprehensive types of the whole class of birds.

The *third* sub-class, or the *Insessores*, includes all the higher land birds. While there is evidently a serial arrangement in this sub-class also, the distinctions are of a nicer character than those which exist between the *Præoces* and the *Altrices* of the second sub-class. New names should be invented to express these distinctions.

All the *Insessores* are understood to be *Altrices*. During the first period of immaturity they all need a nursing mother. Besides this, in birds of the highest series, corresponding very nearly to the *Passeres* of Lillejeborg, there is another character. No covering appears previous to the advent of the true feathers. On some of the feather tracts, especially those of the back, head and thighs, a fine mist-like down appears. Serving no purpose of warmth, it is apparently only the persistence of that which was useful to birds in a lower sub-class. It is unlike the hair like filaments of the Dove and Pigeon, being much branched. Essentially the *Passeres* are nude when they emerge from the egg. *Nudity as well as helplessness characterizes nestlings of the highest series.* When this character appears in a lower sub-class it must be understood as an anticipation.

Passing to the lower series of the Insessorial sub-class, we find three groups; the Birds of Prey or the *Accipitres*, the Cleft Bills or the *Fissirostres*, and the Climbing Birds or the *Scansores*.

Among the Birds of Prey the nestlings are covered both with true down and with plumose filaments attached to the barbs of the feathers, uniting in this respect the characters, both of the *Præcoces* and the *Altrices* below them. From these birds to the *Passeres* through the *Fissirostres* and the *Scansores*, there is a regular gradation in the amount of covering and in the method of growth in the true feathers. The young Night-hawk is clothed with a downy covering; the nestling Swift, Kingfisher, and at least some of the Parrots, present a spinous appearance, resulting from the vigorous growth of feathers in closed follicles.* In the Swift there is neither hair nor down surmounting the follicles.

Were the *Insessorial* sub-class grouped upon the plan of the sub-class below it, we should have an outer triangle composed of the Birds of Prey, the *Fissirostres* and the *Scansores*; and an inner triangle composed of the Tooth-billed birds, or the *Dentirostres*, the slender-billed birds, or the *Tenuirostres*, and the Cone-billed birds, or the *Conirostres*; this inner triangle composing the series of the *Passeres*.

Recent systematists, however, break up the older groups, and in their place substitute among the Passeres two groups, one consisting of the *Oscines* or singers, the other of the *Clamatores* or noise-makers. The *Strisores* of these authors include many birds formerly known as *Fissirostres*, the grouping in the one case being founded on the organs of the voice, and on other anatomical characters; and in the other upon the structure of the bill and upon the general habits and organization which accompany that structure; but in either case the *Passeres* may be considered as one series, and all lower *Insessores*

*From its appearance under the microscope, it is highly probable, that in young Coots, the *down* first presents itself in similar follicles. These follicles variously tinted, doubtless give the brilliant coloring noticed by Gould in Coots of from two to three days old. When the membranes rupture, the beauty vanishes.

By the considerate kindness of Dr. J. Gibbons Hunt, the eminent Microscopist of Philadelphia, a series of observations on the nestling plumage of birds were made during the year 1865. The accuracy of these observations was shown on the publication by the Ray Society of Nitzsch's Pterylography. There are some, however, not given in that remarkable work, which may be figured in subsequent numbers of this volume. It is a suggestive fact, that the young of the *Fissirostral* Caprimulgidæ are covered with down, while the *Tenuirostral* Humming Birds are nude, Lillejeborg and others, including both these families in one group, that of the *Strisores*.

as another. A name should be found to designate the latter series.

Preference has been given to the older grouping, because, apparently, it is founded in Nature. The *Oscines* are treated as the typical forms of the three groups constituting the *Passeres*; the *Clamatores* as lower forms of the same series.

Taken as a whole, then, the class of birds includes three sub-classes, in all three of which are indications of a serial arrangement. The class may be imagined as one branch only of the great Life-system, having a method of branching harmonizing with the other divisions of the animal kingdom, and probably repeating that of the Endogens of the vegetable world.

The grouping in threes which forms such a striking feature in the arrangement of the class of birds, may be seen earlier in the animal kingdom.

The Radiate type divides into three classes. The class of the Polyps divides into three orders. The class of Acalephs has three orders, and it is only the highest class, or the Echinoderms, which has five orders.

The Molluscous type divides into three classes. In the division of these classes into orders there is a play of variation. The class of Acephala has four orders; Gasteropoda three orders, and the Cephalopoda two orders, the number of orders in the type being nine, or a multiple of three. In the Articulate type there are again three classes. In the class of Worms there are three orders, in the class of Crustacea three orders, and in the class of Insects three orders; thus in the type of Articulates there are nine orders, or a multiple of three.

There are those who believe in the universality of groups of fives, according to what is known as the Quinary system. There can be no doubt that both animal and vegetable life do group according to some law of numbers. One, two, three, and multiples of three, four and multiples of four, five, seven, nine, &c., &c., occur in the different groups, with beau-

tiful variations and alternations. In the primary grouping of the Invertebrates, divisions of three are invariable ; it is only in the last and highest type—that of the Vertebrates—that we find four or more classes.* As usually considered, the class of birds is the third great branch of the Vertebrate type.

If the "Tracks" of the New Red Sand Stone, of the Connecticut Valley and other localities, be admitted as indications of bird-like reptiles only, the *Archæopteryx macrurus* is the earliest undoubted representative of the class of Birds, which has yet been revealed to Man. How long this bird and its allies remained the sole representatives of the class, none may know, but when the Struthiones and the Dodo and its allies appeared, a bisection of the branch must already have taken place.† At the appointed time, true to laws governing a world-system, the main branch again budded, sending forth its branches in a double triangle, forming a whorl: the second sub-class, including the Swimmers, the Waders and the Walkers, had its origin. Again was there a period of silent evolution, and when the third branching of the main stem took place, the higher land birds, the *Insessores*, came upon the scene. Highest of these were the *Passeres*, including the Singers—the blossom of Bird-life.

In figure 3, each circle is intended to represent a sub-class. The first sub-class is composed of six sections, the second of six, and the third of six also. Bearing in mind the supposition that each section has its origin in the spiral or spirals of its sub-class, the groups may be arranged thus :

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*Four classes are usually given ; Agassiz perceives eight.

†Prof. Hitchcock thinks the feet of the Struthiones show some resemblance to the bird like tracks of the Connecticut Valley.

CLASS: BIRDS:—AVES.

SUB-CLASS I.—Primores.

Struthiones.	***Inepti.***
OSTRICH AND ALLIES.	DODO AND ALLIES.

SUB-CLASS II.—Terraquatiles.

DIVISION I	SWIMMERS	*NATORES.*
DIVISION II	WADERS	*GRALLATORES.*
DIVISION III	WALKERS	*RASORES.*

		SERIES I. ***Præcoces.***	***SERIES II.*** ***Altrices.***
DIVISION I	NATORES	*Anseres*	*Gaviæ.*
DIVISION II	GRALLATORES	*Grallæ*	*Herodiones.*
DIVISION III	RASORES	*Gallinæ*	*Columbæ.*

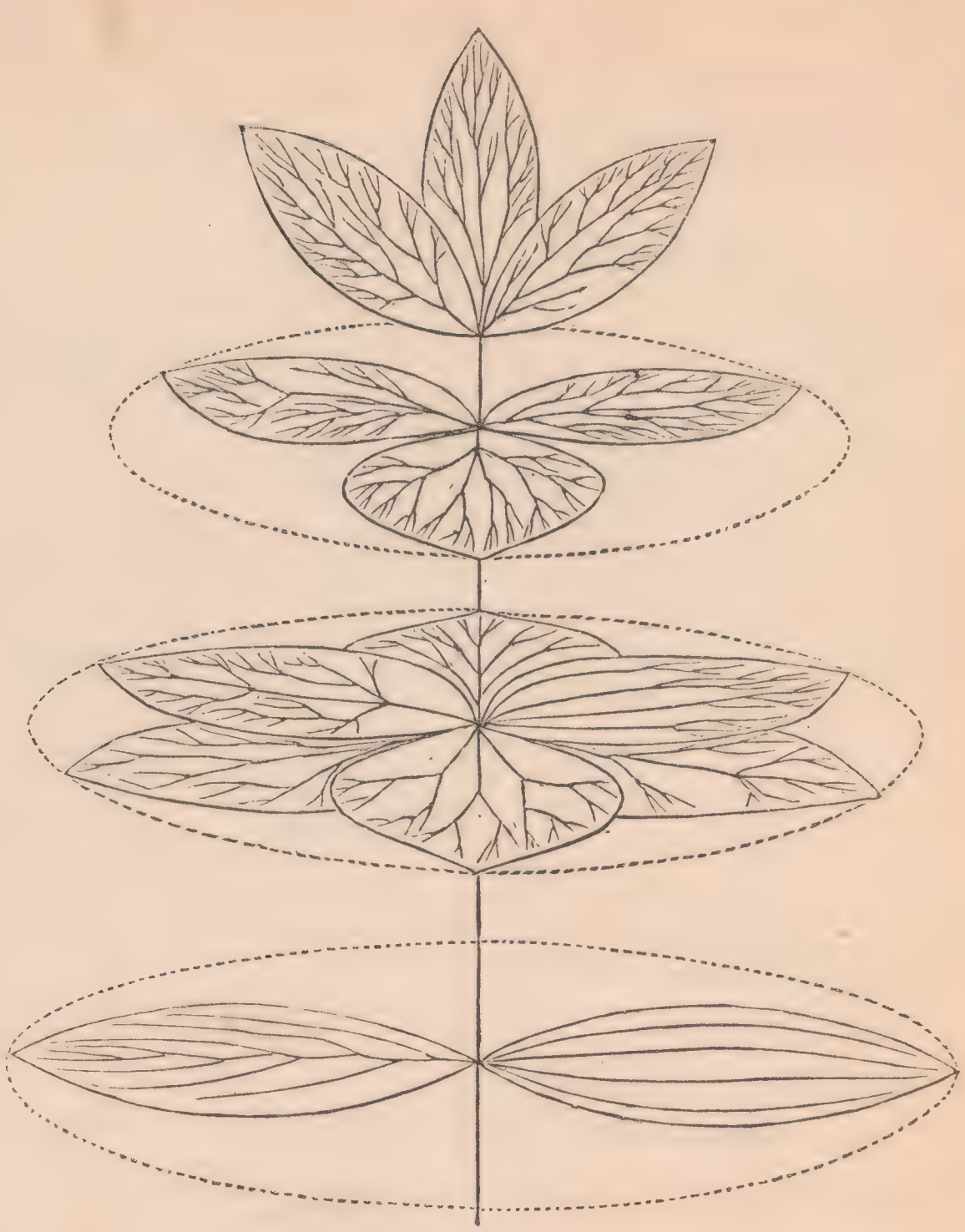
SUB-CLASS III—Insessores.

SERIES I.	***SERIES II.*** ***Passeres.***
BIRDS OF PREY—*Acciptree.*	TOOTH BILLS—*Dentirostres.*
CLEFT BILLS—*Fissirostres.*	SLENDER BILLS—*Tenuirostres.*
CLIMBERS—*Scansores.*	CONE BILLS—*Conirostres.*

*

*The above arrangement. prepared during the Summer of 1867, is allowed to stand because although differing from that of Professor Huxley, it yet approaches his in a remarkable degree, in assigning to the *Struthiones*, the lowest position among existing birds. I have adopted the names of *Primores* for the first sub-class, and *Terraquatiles* for the second, at the suggestion of Prof. Henry Hartshorne.

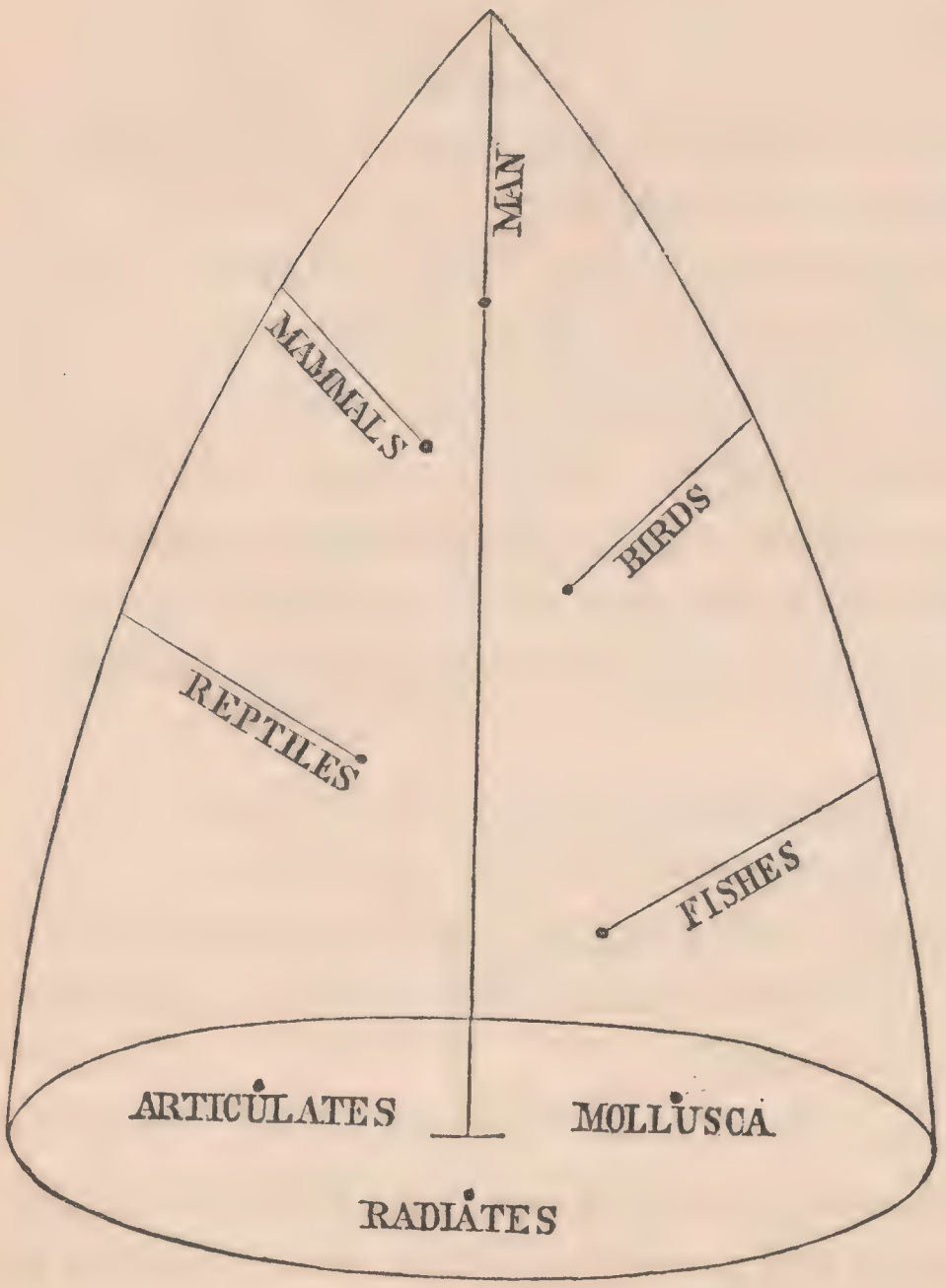
FIGURE 3.



If we consider the matter closely it will appear that the progress from the Radiate to Man does not occur in any direct line, but rather in a spiral around a perpendicular, extending from the base to the apex of a cone, in which the Invertebrates lie at the base, while man occupies the summit; the branches of Fishes, Reptiles, Birds and Mammals, taking their rise at successive points along the spiral. Similarly, the progress within the classes themselves, occurs in a spiral from the point of origination of the class, outward towards the circumference, as trees branch in spirals around the main stem, the whole tree and each of its branches preserving more or less nearly the form of a cone. (Figure 4.) It is not to be

supposed, however, that the Animal Kingdom in its development imitates, as it apparently does, the tree form, but rather that both forms result from the operation of mathematical principles pervading the Universe.

FIGURE 4.



While studying the orbits of the planets and hoping to find them elliptical, Newton, in his investigations, discovered that the mathematical expression he had reached, was not the equation of an ellipse, but a general algebraic expression embracing all the *conic* sections. Observation revealed the fact that the heavenly bodies revolve in *conic* sections; the circle, ellipse, parabola and hyperbola.

Much might be said on the significance of the cone in the animal kingdom, but a few words are sufficient. Did the unknown life-force expand equally in all directions, it would

form a globe. Expanding laterally it does form circles. Expanding laterally and upwards, the resulting form is represented ideally by that of a cone. This cone must be ever expanding unless the life-force is destined to reach a limit, rest, and then ebb back to its Giver. Laterally the expansion is in pulses of growth, upwards it is in a spiral. The branches of the animal kingdom must be understood as tangential forces, themselves expanding in pulses and spirals—the pulses having Æons of ebb and flow.

In the lower orders of the animal kingdom, the life-force is in its fullest expression. The lateral force is nearly equivalent to the upward, and groups of threes, or multiples or variations of threes, are the result. All refinement and elaboration, being displays of power, are exhaustive of force. In the higher groups, the forces are stayed and are permitted to play into more beautiful and graceful methods of branching.

If these suggestions be true, *we shall find all the connecting links for the types, the classes the sub-classes, the orders, or the lesser groups of the animal kingdom, near the point of origination, while the typical forms will be near the periphery of each of the several groups.*

In the progress of this work, we shall endeavor to make apparent the bearing of these views upon classification, but for the present we will proceed with the consideration of the birds.

That which has apparently no meaning in the species, becomes of importance in the series or the sub-class. As we remember, all *Præcoces* are numerous egg-layers, while the *Altrices* of the second sub-class deposit very few eggs. Birds of the Insessorial sub-class vary in the numbers, but finally reach a medium between the two series just mentioned. Let us now recall the generalization of Agassiz, that progeny decreases in an inverse ratio to ascent in the scale of being,

and we shall see that this question of the number of eggs is not without its importance. It is the manifestation in the class of birds of a law applying to the whole animate creation. Remember the countless myriads produced by the Radiate animals, the multitudinous increase of the Mollusks, the scarcely inferior numbers of the Articulates, and, reaching the Vertebrates, the small and numerous eggs of the Fishes, the larger and fewer of the Reptiles, and the still larger and fewer eggs of the Birds. Judging the birds, then, by the general law in relation to numbers, it would appear that the *Præcoces*, with numerous young, are the lowest in the Ornithological scale; that a reaction then occurs in the Altrices, causing them to rise above the true level, while the higher land birds, after many variations dependent on their grouping, finally gain the true standard of increase in the four and five eggs of the singing bird. It seems apparent that the mean number of eggs for every one of the eight or ten thousand species of birds in the class, is just as accurately appointed as are leaves and flowers in the vegetable world.

Nor are form, color and quality, of less significance when considered in reference to the eggs of the whole class.

Too little is known of the birds of the first sub-class to justify any confident deductions. We may observe, however, that the eggs of the Ostrich are of a broad oval, while those of the Æpyornis, $13\frac{1}{2}$ inches in length, by 11 in diameter, are of a longer oval, obtuse at the end. This latter form is re-produced in the eggs of the *Megapodidæ*, or Mound birds of Australia, and the Pigeons differ only in reaching a truer oval. All the eggs in this sub-class are large, the birds which produce them being the giants of their kind. In color they vary from a white to a rich oil-green, and while some have a hard and compact shell, others are of a chalky nature.

A word or two is here needed on the formation of egg-shells. As has been shown by Professor Agassiz in relation to Turtles, the shells of eggs are formed by a deposit of calcareous crystals and albuminous matter. Where the shell is rough

and chalky, the crystals are widely separated; where hard and crystalline, the little crystals interlock with each other, the albuminous deposit serving as a cement to render them still more compact and glossy. As examples of chalky eggs among birds, we may take those of the Emeu, the Flamingo, the Albatross, the Megapodius, the Crotophaga,—or Black Parrot, one of the Cuckoo family, found from Florida to Brazil, and others. As examples of crystalline eggs, those of the Woodpeckers, of some of the Owls, the Kingfisher, and several allied groups, will suffice. Most beautiful of all, however, are the eggs of the Tinamous—partridge-like birds found mainly in South America, but sparingly represented in the old world. The finest porcelain could not compare in beauty with these eggs, many of which are of a soft neutral tint unlike any other eggs among birds.

The majority of eggs, however, are neither chalky nor crystalline, but of that medium hardness which we see in the eggs of the barn-door fowl, the Duck, the Partridge, the Pigeon, Blue-bird and Thrush. The *quality* of the shell is worth attention. There may be differences of structure repeated in the successive groups of birds. Nay, it may even be a question whether these differences are not repetitions of those found in another class—that of the Reptiles.

In relation to *Form*, we find the oval egg of all the *Anseres*, contrasting with the egg pointed at one end, of the majority of the *Longipennes*, perhaps a majority of the *Brachypteri*, and some of the *Totipalmi*, tribes of the diverse *Gaviæ*. Conversely, we see the egg pointed at one end belonging to the *Grallæ*, contrasting with the oval egg of the *Herodiones*; while between the *Gallinæ* and the *Columbæ*, each the typical groups of their series, there is less difference of form. The eggs of the *Columbæ* are always oval, unless it be in groups modified by the approach of other forms. In each group, such modifications do occur, and they take place in the lesser groups according to laws affecting the greater. There is, at

the same time, a kind of alternation which suggests the true oval as the ideal form. If some members of a group depart from an oval so far as to present eggs inclining to be globular, other members will recede to the opposite extreme, showing eggs with a lengthened axis, the mean for the group being apparently a true oval. This tendency to extremes, moreover, appears peculiarly to characterize the eggs of birds belonging to the second sub-class, and the lower members of the third. In the first sub-class, the forms are to a certain extent unspecialized; in the higher members of the Insessorial sub-class, they have reached their nicest balance of form, a nearly true oval, or an egg slightly pointed at one end. This is the most common form among the *Oscines*, the highest members of the *Passeres*.

Among the Birds of Prey, the eggs of the Owl family are nearly globular, those of the American Vultures are unusually elongated, while the eggs of the Falconidæ are intermediate in form. The eggs of the Kingfisher are nearly globular. The general form in the family of the Caprimulgidæ is a fine oval; but on one hand in this family, in Australian species which connect with the Owls, the eggs are nearly globular, while on the other hand in species leading to another group, the eggs are of a long oval. These differences of form are suggestive, and might be used to advantage in assisting to determine the relationships of obscure Insessorial birds.

In *color*, very nearly the same alternations occur, the complementary groups of each division forming contrasted, but harmonizing couples.

The eggs of many, perhaps a majority of the *Anseres*, are white; on one hand there is a shading towards brownish green, on the other a faint suggestion of the coming ferruginous of the Birds of Prey, but all or nearly all are unspotted; these contrast with the *Gaviæ* as a whole; but if the tribes of the latter group were arranged according to the eggs, there would be four groups instead of three, and these groups would al-

ternate by twos; the *Brachypteri* would contrast with the *Totipalmi*, and the *Tubinares** with the *Longipennes*.

The eggs of the typical *Grallæ* are richly and very beautifully spotted. Near the point of origination for the whole group, there is a tendency towards the rich oil-green color seen earlier in the eggs of the Emeu.

Among the *Herodiones*, the eggs are either perfectly plain or more delicately spotted than among the *Grallæ*.

The eggs of the typical *Gallinæ* are perhaps usually spotted; but on the one hand the color approaches the pure white of the *Columbæ*, and on the other, through the family of the *Tinamous*, after passing through various shades of neutral and stone-color, reaches the oil-green of the Emeu.

Looking at the three sections which constitute the *Præcocial* series, we find one group with eggs entirely plain, one with richly marked eggs; and one with an intermediate degree of spotting. Of the three sections which form the *Altricine* series, one possesses groups alternating with each other; in one the eggs are entirely plain; and in the other they are nearly all unspotted.

Passing upwards to the Insessorial sub-class, we encounter the Birds of Prey. Here the eggs of the Owls are white, some of them purely crystalline; the eggs of the Vultures reach a richness of tinting found in few other groups, but among themselves they vary from delicate rufous to rich chocolate-brown blotchings, and from thence, as for example in the Condor, to unspotted white, with only occasional markings; the eggs of the Falconidæ are of various shades of ferruginous—on either hand fading off to white.

In the *Caprimulgidæ* or Night-hawk family, which connect with the Owls, the eggs are usually mottled with wonderful delicacy and beauty, and with various intermingled shades of soft colors; but in those Australian species which on the one hand lead to the Owls, and on the other to an adjacent group,

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*Birds with tubular nostrils, as the Albatrosses and Petrels.

the eggs are of an immaculate whiteness. In the Kingfisher family and in a number of allied groups, the eggs are of the same crystalline purity. The *central point of the Insessorial sub-class may possibly be marked by the pure white of the eggs.*

The eggs of the *Passeres* appear to be repetitions of all the lower groups, modified so variously that it would be hopeless to attempt their exposition, without long and attentive study of each separate family and genus. While the similarity is too apparent to escape notice, it is a similarity under new conditions. The extremes met with in the lower groups, are seldom found in the higher; a true mean has been attained; the ideal is reached and exemplified. No character is accidental. Being dependent on some general law, the law proclaims a Lawgiver. Who would have supposed that even in the form, the quality and the color of the eggs of birds, the majestic flow of the tidal forces of life could be expressed; and yet nothing is more apparent when the whole class of Birds is examined. But it is not in the eggs only. In other characters of the divisions, the series, and the minor groups, there is a rhythm the cadences of which are only perceived by the closest study. For every extreme there is a just balance in each sub-class, and the resultant harmony is repeated in the next with new modulations; thus is each new circle of growth a modification of some lower form, at the same time that it is another and more perfect expression of the Divine Ideal.

What is true of the class of Birds is true of all life.

In the language of Professor Tyndall: "Waves may change to ripples, and ripples to waves—magnitude may be substituted for number, and number for magnitude—asteroids may aggregate to suns, suns may resolve themselves into floræ and faunæ, and floræ and faunæ melt into air—the flux of power is eternally the same. It rolls in music through the ages, and all terrestrial energy,—the manifestation of life as well as the display of phenomena, are but the modulations of its rhythm."

We can scarcely avoid the conclusion that the whole Animal Kingdom, with its types, and their branching classes, unfolds as the plant unfolds from the tiny seed, or as the animal developes from the ovum, in an ordered growth, according to a perfect conception of the Divine Mind, and upon principles coexistent with Eternity.

Well may the poet exclaim:

"O Thou eternal One! whose presence bright
All space doth occupy, all motion guide;
Unchanged through time's all devastating flight;
Thou only God! There is no God beside!
Being above all beings! Mighty one!
Whom none can comprehend and none explore;
Who fill'st existence with Thyself alone:
Embracing all—supporting, ruling o'er—
Being whom we call God—and know no more!"